

VASCULAR PLANTS OF RICHVALE VERNAL POOLS, BUTTE COUNTY, CALIFORNIA

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ABSTRACT

The Richvale Vernal Pools site in the Sacramento Valley of northern California is a 32.4 hectare grassland with 120 vernal pools of varying sizes occurring on its alluvial soils. The flora contains 45 families, 131 genera and 184 species of vascular plants, all flowering plants except for two. Annuals comprise 74.5% of the species. As is typical of annual grasslands in lowland California, a portion of the flora consists of introduced plants: the flora occurring in vernal pools is 93% natives, while the grassland matrix between pools is 67% natives. The largest family, Poaceae, contributes the most non-natives (i.e., 22 introduced, 6 native grasses). Asteraceae is also well represented, but mainly by natives (5 introduced, 18 native). Richvale Vernal Pools is important as a diverse remnant of grassland/vernal pool ecosystems in a region almost entirely cultivated in rice.

Richvale Vernal Pools occurs as a 32.4 hectare remnant of grassland in the northern Sacramento Valley, 31.5 km south of Chico, California (Fig. 1). This land is surrounded on the north, west, and south by cultivated ricelands, and on the east by California Highway 99 and a reservoir, the Thermalito Afterbay. This parcel of land has never been plowed and has suffered only relatively minor disturbance. A low hill in the east-central portion bears remains of a small grove of osage-orange and fig trees. More marked disturbances are the drainage ditch running east-west across the parcel (Fig. 1), the revegetated mounds of soil along this ditch, and several adjacent ditches that dry completely each year and harbor native vegetation. There was grazing here by 3 to 5 horses in 1979 and 1980. As in grasslands throughout northern California at present (Heady 1977), the regions between the vernal pools contain many naturalized annual grasses. Within this grassland matrix is found the largest known assemblage of vernal pools remaining in the northern Central Valley of California (Sanders 1981).

At Richvale, as is usual within groups of vernal pools that have been studied (e.g., Jain 1976), the flora of adjacent pools differs. Detailed examples of species frequency, density, and cover in nearby pools at Richvale are reported elsewhere (Schlising and Sanders 1982). The variation in size, depth, substrate, and flora in the large number of adjacent pools make the Richvale site very valuable. The isolation and the remnant nature of this land in an agricultural area also make Richvale Vernal Pools and its biota uniquely important.

Elevation at the site ranges from about 33.5 to 38.1 m above sea

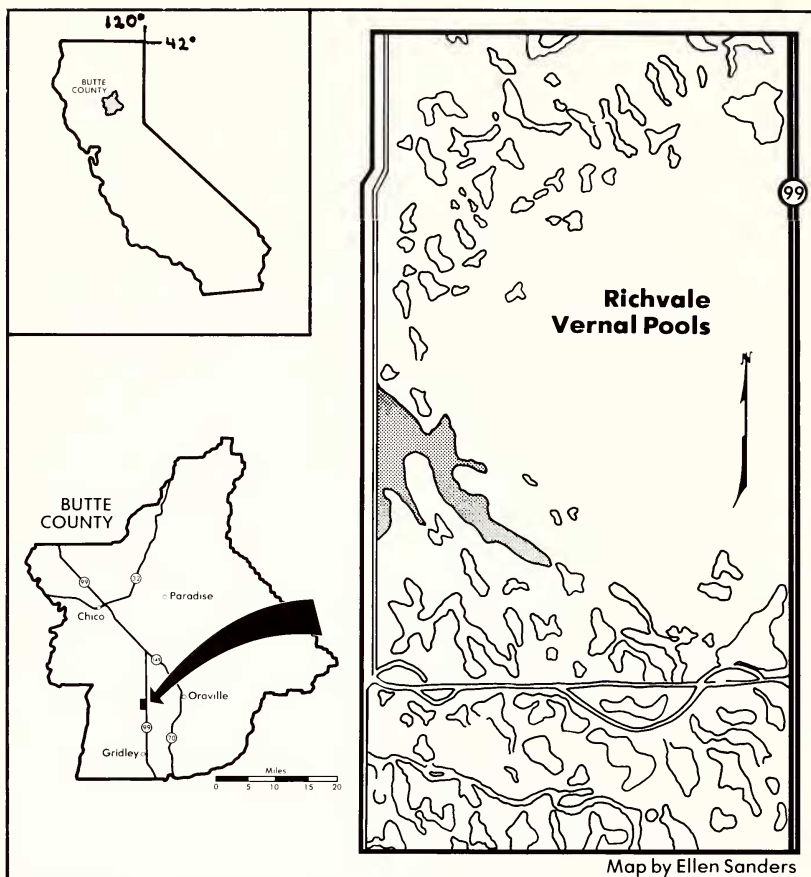


FIG. 1. Location and details of Richvale Vernal Pools, Butte County (T19N, R2E, section 24), California. High-water line of the pools in 1980 is shown; the border of the shaded pool is at 33.5 m above sea level (pool map from Sanders 1981).

level. Precipitation data taken at the Richvale Rice Experiment Station, 4 km to the southwest, show a mean of 48.89 cm annually from 1931 through 1961; more recent records are incomplete (Calif. Resources Agency 1980). Climate maintaining these typical grassland and vernal pool habitats is Mediterranean. The rainy winters fill the pools that have cemented hardpans below them. The rising temperatures and lack of precipitation in spring cause the drydown of the pools and the mostly vernal flowering of their largely endemic flora (Schlising and Sanders 1982).

There are about 120 depressions and pools at Richvale that vary in area from several m² to 7293 m² (Sanders 1981). Soils have developed from alluvium, and are red, gravelly loams of the San Joaquin series, which generally have an iron silicate hardpan within a meter of the soil surface (Holland 1978). However, the largest pool (shown shaded in Fig. 1) has a different, probably older substrate with a markedly higher clay content. This lower area has a flora somewhat different from the remainder of the 32.4 ha. (At least 6 taxa are found here only: *Evax caulescens*, *Hemizonia luzulaefolia* subsp. *rudis*, *Navarretia heterandra*, *N. nigellaeformis*, *Tuctoria* (*Orcuttia*) *greenei*, and *Trifolium variegatum*.) This large (but very shallow) pool is referred to as the "largest pool" in the checklist that follows.

The vascular plant flora contains 45 families, 131 genera and 184 species (plus four additional subspecies). With the exception of one species of fern and one quillwort (*Isoetes*), these are all flowering plants. Of the total flora, 137 species (74.5%) are annuals and 123 species (66.8%) are native to California.

When the flora is considered roughly by habitat, 93% of the species typically found in the vernal pools are natives. Within the grassland matrix about 67% of the species are natives. Along, as well as in, the ditches and on the hilltop (comprising a relatively small area of the Richvale site), the native component in the flora drops to 45% of the species.

The families best represented are: Poaceae (6 native species/28 total species), Asteraceae (17/23), Fabaceae (8/14), Scrophulariaceae (8/9), Polemoniaceae (7/7), Boraginaceae (7/7), Brassicaceae (5/7), Amaryllidaceae (6/6), Caryophyllaceae (2/6), Juncaceae (5/5), Onagraceae (5/5), and Ranunculaceae (4/5). Thirty-two percent of the introduced species present are in the Poaceae. Of the nine grasses found in the vernal pools, one, *Tuctoria* (*Orcuttia*) *greenei*, is a rare plant protected by legislation in the state of California.

This list of vascular plants from the pools and from the grassland matrix among the pools was prepared by observation and collecting from 1978 through 1983. Names follow Munz (1968); recent nomenclature is based on an unpublished checklist ("Flora Buttensis") by M. S. Taylor. Voucher specimens are in the Herbarium at California State University, Chico (CHSC). Species are classified relatively as rare, infrequent, frequent, common, or abundant. Species found in vernal pools are marked with a #; introduced species are marked with an asterisk.

LYCOPHYTA

Isoetaceae

#*Isoetes nuttallii*. Perennial, common in vernal pools.

PTEROPHYTA

Marsileaceae

#*Pilularia americana*. Perennial, frequent in vernal pools.

ANTHOPHYTA—DICOTYLEDONEAE

Aizoaceae

**Mollugo verticillata*. Introduced annual, infrequent in deep ditches that dry in summer, but not in vernal pools.

Apiaceae

#*Eryngium vaseyi* var. *vallicola*. Perennial, common in pools and moist areas between pools.

Lomatium humile. Perennial, frequent in higher areas away from pools.

Sanicula bipinnatifida. Biennial or perennial, infrequent in higher areas away from pools.

Asteraceae

#*Achyrachaena mollis*. Annual, common in shallow pools, pools margins and moist slopes.

#*Blennosperma nanum*. Annual, infrequently found near pools.

**Centaurea solstitialis*. Annual, frequent on mounds along ditches and in heavily disturbed flatter areas.

**Conyza canadensis*. Annual, infrequent on mounds and sides of ditches.

#*Evax caulescens*. Annual, common in largest pool and adjacent clayey flats.

Filago californica. Annual, infrequent in grasslands.

Gnaphalium chilense. Annual or biennial, frequent on moist sides of ditches.

Grindelia camporum. Perennial, with one population on mound by ditch.

#*Hemizonia fitchii*. Annual, common throughout area, including some pools.

#*Hemizonia luzulaefolia* subsp. *rudis*. Annual, abundant in largest pool and adjacent clayey flats.

#**Hypochoeris glabra*. Annual, common throughout grasslands and frequent in some shallow pools.

**Lactuca serriola* var. *serriola*. Annual, infrequent in grasslands.

**Lactuca serriola* var. *integrata*. Annual, rare in grasslands.

Lagophylla glandulosa subsp. *glandulosa*. Annual, frequent throughout area between pools.

Lagophylla glandulosa subsp. *serrata*. Annual, rare in area; considered an early-flowering ecotype.

#*Lasthenia fremontii*. Annual, abundant in pools.

- #*Lasthenia glaberrima*. Annual, known in one southeastern pool.
 #*Layia fremontii*. Annual, common throughout area, including shallow pools.
Micropus californicus. Annual, infrequent throughout grasslands.
 #*Microseris douglasii*. Annual, common throughout, including shallow pools.
 #*Psilocarphus brevissimus*. Annual, abundant in vernal pools throughout.
 #*Psilocarphus oregonus*. Annual, infrequent in shallow pools.
 #*Psilocarphus tenellus* var. *tenuis*. Annual, known in one shallow southeastern pool.
 **Senecio vulgaris*. Annual, infrequent in disturbed areas.
Solidago occidentalis. Perennial, rare in ditch along west side.

Boraginaceae

- Amsinckia intermedia*. Annual, rare on hill near Highway 99.
Plagiobothrys fulvus var. *campestris*. Annual, common between pools and especially on hill.
 #*Plagiobothrys greenei*. Annual, common in shallow pools, pool margins and low areas.
 #*Plagiobothrys leptocladus*. Annual, known in several pools near cross ditch.
Plagiobothrys nothofulvus. Annual, rare in areas between pools.
 #*Plagiobothrys stipitatus* var. *stipitatus*. Annual, abundant in largest pool and adjacent clayey flats.
 #*Plagiobothrys stipitatus* var. *micranthus*. Annual, common in deeper pools throughout area.

Brassicaceae

- **Capsella bursa-pastoris*. Annual, rare on hill.
Cardamine oligosperma. Annual, rare in grasslands.
 #*Lepidium nitidum*. Annual, common at pool margins and in low areas.
Rorippa palustris subsp. *occidentalis*. Annual, rare in ditches.
 **Sisymbrium officinale*. Annual, in heavily trampled areas under trees on hill.
Thysanocarpus radians. Annual, infrequent between pools.
Tropidocarpum gracile. Annual, rare on hill.

Callitrichaceae

- #*Callitriche longipedunculata*. Annual, in deeper vernal pools and ditches.
 #*Callitriche marginata*. Annual, in deeper pools and ditches.

Campanulaceae

- #*Downingia bella*. Annual, abundant in vernal pools throughout.

- #*Downingia bicornuta*. Annual, common in vernal pools throughout.
 #*Downingia ornatissima*. Annual, common in vernal pools throughout and in adjacent moist areas.
Githopsis specularioides. Annual, rare in higher areas.

Caryophyllaceae

- **Cerastium glomeratum* [*C. viscosum*]. Annual, infrequent in disturbed areas.
 **Petrorhagia velutina* (Gussone) Ball and Heywood [*Tunica prolifera*, *Kohlrauschia velutina*]. Annual, infrequent in grasslands.
 #*Sagina apetala* Ard. [*S. apetala* var. *barbata*]. Annual, infrequent in shallow pools and low areas.
 #*Sagina decumbens* (Ell.) Torr. & Gray subsp. *occidentalis* (Wats.) Crow [*S. occidentalis*]. Annual, infrequent in shallow pools and low areas.
 **Silene gallica*. Annual, infrequent in disturbed areas.
 **Stellaria media*. Annual, infrequent in disturbed areas.

Convolvulaceae

- **Convolvulus arvensis*. Perennial, rare in trampled area under trees on hill.

Crassulaceae

- #*Crassula aquatica* (L.) Schonl. [*Tillaea aquatica*]. Annual, common in shallow pools, in horse trails and other low or open areas.
Crassula erecta (H. & A.) Berger [*Tillaea erecta*]. Common in low areas.
 **Crassula muscosa* (L.) Roth [*Tillaea muscosa*]. Common in low areas.

Cuscutaceae

- #*Cuscuta howelliana* Rubtzoff. Annual, common throughout (especially in southwest corner) in pools and at pool margins; fruiting mostly on *Eryngium*.

Euphorbiaceae

- #*Eremocarpus setigerus*. Annual, common throughout, especially in shallow pools.
 #*Euphorbia ocellata*. Annual, infrequent in shallow pools.

Fabaceae

- Lotus purshianus*. Annual, abundant near cross ditch.
Lotus subpinnatus. Annual, infrequent near ditches.
Lupinus bicolor subsp. *pipersmithii*. Annual, common between pools.
 **Medicago polymorpha* var. *polymorpha* [*M. hispida*]. Annual, infrequent in disturbed areas.

**Medicago polymorpha* var. *brevispina* [*M. hispida* var. *confinis*].
Annual, infrequent in disturbed areas.

#*Trifolium depauperatum*. Annual, common in some shallow pools
and in flat areas.

**Trifolium dubium*. Annual, infrequent near cross ditch.

**Trifolium hirtum*. Annual, common throughout between pools.

Trifolium microcephalum. Annual, frequent throughout grasslands.

**Trifolium subterraneum*. Annual, infrequent at margins of area.

#*Trifolium tridentatum*. Annual, infrequent in shallow pools.

#*Trifolium variegatum*. Annual, common in and near largest pool.

**Vicia angustifolia*. Annual, infrequent near cross ditch.

**Vicia sativa*. Annual, infrequent, especially in heavily disturbed areas
near Hwy 99.

**Vicia villosa*. Annual or biennial, infrequent along ditches.

Gentianaceae

#*Centaurium floribundum*. Annual, in several pools, including largest,
and along ditches.

#*Cicendia quadrangularis*. Annual, frequent in shallow pools, flat
areas and horse trails in higher areas.

Geraniaceae

**Erodium botrys*. Annual, common throughout grasslands, especially
lower areas between pools.

**Erodium moschatum*. Annual, rare under trees on hill.

**Geranium dissectum*. Annual, infrequent in grasslands.

**Geranium molle*. Annual, rare under trees on hill.

Haloragaceae

Myriophyllum exalbescens Fern. [*M. spicatum* subsp. *exalbescens*].
Perennial, common in irrigation ditch on west side.

Hypericaceae

**Hypericum perforatum*. Perennial, infrequent along cross ditch.

Lamiaceae

#*Pogogyne zizyphoroides*. Annual, common in shallower pools and
margins of deeper pools throughout.

#*Trichostema lanceolatum*. Annual, common throughout area, including
vernal pools.

Lycopus americanus. Perennial, common in cross ditch.

Lentibulariaceae

Utricularia gibba. Annual, rare in cross ditch.

Limnanthaceae

#*Limnantes alba*. Annual, common in most pool margins and in adjacent low areas.

Lythraceae

#*Lythrum hyssopifolia*. Annual, common in pools and low areas throughout.

Malvaceae

**Malva neglecta*. Annual, rare under trees on hill.

#*Sidalcea diploscypha*. Annual, rare on slopes and at pool margins.

#*Sidalcea hirsuta*. Annual, in large pool and rare in other pools.

Moraceae

**Ficus carica*. Few trees on hill.

**Maclura pomifera*. About twelve decrepit trees on hill.

Onagraceae

#*Boisduvalia cleistogama*. Annual, rare in widely separated pools.

#*Boisduvalia stricta*. Annual, common at pool margins and in low areas.

#*Clarkia purpurea* subsp. *quadrivulnera*. Annual, common between pools and at pool margins.

Epilobium paniculatum. Annual, rare in cross ditch.

Ludwigia peploides. Perennial, abundant in cross and west ditches.

Papaveraceae

Eschscholzia lobbii. Annual, frequent between pools, especially in south portion.

Plantaginaceae

**Plantago lanceolata*. Perennial, infrequent along ditches.

Polemoniaceae

Linanthus bicolor. Annual, frequent between pools throughout area.

#*Navarretia heterandra*. Annual, found only in largest pool and adjacent clayey flats.

Navarretia intertexta. Annual, collected in 1978 (*M. S. Taylor 1611*), but not relocated.

#*Navarretia leucocephala*. Annual, abundant in pools throughout.

#*Navarretia nigellaeformis*. Annual, common in largest pool and adjacent clayey flats.

Navarretia pubescens. Annual, infrequent in grasslands.

#*Navarretia tagetina*. Annual, common throughout at pool margins and in grasslands between pools.

Polygonaceae

**Rumex crispus*. Perennial, scattered throughout grasslands, especially near ditches.

**Rumex pulcher*. Perennial, infrequent, especially near ditches.

Polygonum punctatum. Perennial, common in cross ditch.

Portulacaceae

Calandrinia ciliata var. *menziesii*. Annual, rare between pools.

Claytonia perfoliata subsp. *perfoliata*. Annual, infrequent on hill among trees.

Montia fontana L. subsp. *chondrosperma* (Fenzl.) Walt. [*M. verna*, *M. minor*]. Annual, common throughout in low areas and along horse trails.

Primulaceae

**Anagallis arvensis*. Annual, rare in largest pool.

#*Anagallis minima* [*Centunculus minimus*]. Annual, infrequent in pools.

Ranunculaceae

Delphinium variegatum. Perennial, infrequent in higher grassland.

#*Myosurus minimus*. Annual, infrequent in pools.

#*Ranunculus bonariensis* var. *trisepalus*. Annual, rare in cross ditch and several pools.

Ranunculus aquatilis var. *hispidulus*. Perennial, in deeper ditches.

**Ranunculus muricatus*. Annual or perennial, infrequent in cross ditch.

Rubiaceae

**Galium tricorne*. Annual, common in southeast corner.

Salicaceae

Populus fremontii. Few saplings in ditch on west side.

Salix gooddingii. Few plants in ditch on west side.

Salix hindsiana. Few plants in ditch on west side.

Scrophulariaceae

#*Gratiola ebracteata*. Annual, common in pools.

Lindernia dubia (L.) Penn. var. *anagallidea* (Michx.) Cooperrider [*L. anagallidea*]. Annual, rare on banks of cross ditch.

#*Mimulus guttatus*. Annual, infrequent in cross ditch and in some pools.

#*Mimulus tricolor*. Annual, infrequent in pools.

Orthocarpus attenuatus. Annual, frequent in areas between pools.

#*Orthocarpus campestris*. Annual, infrequent in pools throughout.

#*Orthocarpus erianthus*. Annual, common in lower areas and at pool margins.

- **Verbascum blattaria*. Biennial, rare on bank of cross ditch.
 #*Veronica peregrina* subsp. *xalapensis*. Annual, uncommon in pools throughout.

Solanaceae

- **Lycium halimifolium*. One shrub near trees on hill.

ANTHOPHYTA—MONOCOTYLEDONEAE

Alismataceae

- Alisma triviale*. Perennial, in cross ditch.
 #*Sagittaria calycina* Engelm. [*S. montevidensis* subsp. *calycina*]. Perennial, infrequent in cross ditch.

Amaryllidaceae

- #*Allium amplexans*. Perennial, common throughout in low areas and in many shallow pools.
Brodiaea coronaria. Perennial, infrequent on higher ground.
 #*Brodiaea minor*. Perennial, common between, and sometimes in pools.
Dichelostemma multiflorum (Benth.) Heller [*Brodiaea multiflora*]. Perennial, common between pools.
Dichelostemma pulchellum (Salisb.) Heller [*Brodiaea pulchella*]. Perennial, infrequent between pools.
 #*Triteleia hyacinthina* (Lindl.) Greene [*Brodiaea hyacinthina*]. Perennial, common between pools and in margins of shallow pools.

Cyperaceae

- Cyperus eragrostis*. Perennial, infrequent along ditches.
 #*Eleocharis macrostachya* Britton. Perennial, infrequent as dense clumps in deeper pools.
Scirpus acutus. Perennial, in central part of cross ditch.

Hydrocharitaceae

- Elodea canadensis*. Perennial, in ditches.

Juncaceae

- Juncus acuminatus*. Perennial, infrequent in ditches.
 #*Juncus bufonius*. Annual, common in pools, in low areas, and on horse trails.
 #**Juncus capitatus*. Annual, frequent in pools throughout.
 #*Juncus oxymeris*. Perennial, rare in a few pools.
 #*Juncus uncialis*. Annual, frequent at pool margins, especially on pocket gopher soil-mounds.

Liliaceae

Calochortus luteus. Perennial, rare near center of area.

Chlorogalum angustifolium. Perennial, common throughout grassland area.

Poaceae

**Aegilops triuncialis*. Annual, infrequent as dense populations in grassland.

**Agrostis avenacea*. Perennial, infrequent in cross ditch.

**Aira caryophyllea*. Annual, common throughout grassland area.

#*Alopecurus saccatus*. Annual, common in some pools.

**Andropogon glomeratus*. Perennial, rare in ditches.

#*Aristida oligantha*. Annual, frequent throughout, in pools and low areas.

**Avena barbata*. Annual, frequent throughout grassland.

**Briza minor*. Annual, common throughout grassland.

**Bromus diandrus* [*B. rigidus*]. Annual, infrequent throughout grassland.

**Bromus mollis*. Annual, the most abundant grassland species throughout.

**Bromus rubens*. Annual, common throughout grassland.

**Cynodon dactylon*. Perennial, infrequent near cross ditch.

#*Deschampsia danthonioides*. Annual, common in pools, especially at margins.

#**Gastridium ventricosum*. Annual, frequent throughout, sometimes in pools.

**Hordeum geniculatum* [*H. hystrix*]. Annual, infrequent.

**Hordeum glaucum* [*H. stebbinsii*]. Annual, common in grassland.

#**Hordeum leporinum*. Annual, common in grassland and in some pools.

**Lolium multiflorum*. Annual, common in grassland.

**Paspalum dilatatum*. Perennial, common along ditches.

**Poa annua*. Annual, infrequent in disturbed areas like ditch banks.

#**Polygogon maritimus*. Annual, common in disturbed areas and frequent in many vernal pools.

#*Phalaris lemmonii*. Annual, infrequent in some pools.

#**Phalaris paradoxa*. Annual, infrequent in some pools.

Setaria geniculata. Perennial, infrequent at ditch margins.

**Taeniatherum caput-medusae* (L.) Nevski [*T. asperum*]. Annual, infrequent as dense populations in grassland.

#*Tuctoria greenii* (Vasey) J. Reeder [*Orcuttia greenii*]. Annual, known only from one small population in the largest pool.

**Vulpia bromoides* (L.) S. F. Gray [*Festuca dertonensis*]. Annual, infrequent along ditch banks and in areas between pools.

Vulpia microstachys (Nutt.) Benth. var. *microstachys* [*Festuca microstachys*]. Annual, infrequent in grassland.

**Vulpia myuros* (L.) Gmelin var. *hirsuta* Hack. [*Festuca megalura*]. Annual, infrequent along ditch banks and in areas between pools.

Pontederiaceae

**Heteranthera limosa*. Perennial, infrequent in cross ditch.

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